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ABSTRACT

This paper examines the expenditure patterns of public doctorate-granting institutions, the tradeoffs made among competing financial needs by these institutions, and how well these expenditure patterns may validate the Carnegie classifications of the examined institutions. The paper presents data collected from 133 institutions in the Research I, Research II, Doctorate-granting I, and Doctorate-granting II Carnegie classification groups, including the following financial variables: total fiscal year 1988 educational and general expenditures and mandatory transfers (E&G) and present E&G in each of the following areas: instruction, research, public service, academic support, institutional support, student services, and operation and maintenance of plant. Using Pearson correlation coefficients, the relationships among competing expenditure allocation choices are shown, and through the use of discriminant analysis, these allocations are used to validate the Carnegie classifications of the institutions, as well as to determine how the institutions would be reclassified into other Carnegie groups based solely on their spending patterns. Study results indicate that only research and public service are positively correlated with total E&G expenditures; all other allocation ratios show negative relationships with E&G. The relationship between instruction and research showed the strongest negative correlation between any two variables. Percent spent on instruction showed positive relationships with student services, institutional support, and plant operation. Using spending patterns to validate Carnegie classifications resulted primarily in reclassifications from Research II and Doctoral II categories into Research I and Doctoral I categories. (Contains 14 references.) (GLR)

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An Analysis of Expenditure Allocation and its Relationship to Institutional Classification

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ABSTRACT

This study examines the expenditure patterns of public, doctorate-granting institutions, the tradeoffs made among competing financial needs by these institutions, and determines how well these expenditure patterns may validate the Carnegie classifications of the examined institutions. Using Pearson correlation coefficients, the relationships among competing expenditure allocation choices (e.g., instruction, research, student services) are shown, and through the use of discriminant analysis, these allocations are used to validate the Carnegie classifications of the institutions, as well as to determine how the institutions would be reclassified into other Carnegie groups based solely on their spending patterns.

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This paper was presented at the Thirty-Second Annual Forum of the Association for Institutional Research held at the Atlanta Hilton & Towers, Atlanta, Georgia, May 10-13, 1992. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum Papers.

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The development of meaningful taxonomies of organizations has long been viewed as critical to the health of these organizations (McKelvey, 1975), including institutions of higher education. To that end, McKelvey states that the development of multivariate methods of classification is necessary for useful organizational taxonomies.

Many attributes have been used to classify colleges and universities, from the very basic notions of size, control, and mission used by Gleckner (1988), to many other more sophisticated variables involving students, faculty, finances, and even organizational climate (Lysons, 1990). Gleckner, for example, uses simple variables to differentiate among the possible teaching environments and their implications for new faculty members. Lysons, on the other hand, is more concerned with the taxonomic implications of using organizational climate as a more sophisticated measure in order to improve classification of institutions of higher education. Clearly, the possible combinations, methods, and purposes of classifying colleges and universities are practically endless. One of the most widely accepted classifications of colleges and universities, developed by the Carnegie Foundation for the Advancement of Teaching (1987), uses variables such as number of doctoral degrees awarded, federal funding for research and development, and academic program mix to classify institutions. Federal support for research is of particular interest to large, research-oriented universities, of course, and consequently much research has been done about the factors relating to its level (Ellyson & Krueger, 1980; Muffo & Coccari, 1982; Wolfle, 1982; Kinnick & Ricks, 1990).

In fact, although financial data in general are among the most frequently used for comparison and classification of institutions (Lane, Lawrence, & Mertins, 1987; Teeter & Brinkman, 1987), little effort has been made to use financial characteristics to validate generally accepted taxonomies, such as the Carnegie classifications.

Another aspect of higher education finance that has received relatively little attention is the interrelationship among certain types of key variables, such as expenditure and revenue patterns as reflected in financial ratios. Although a great deal of prescriptive literature exists regarding the use of financial ratios in higher education (Minter, et al., 1982; Woelfel, 1987; DiSalvio, 1989), little has been done to examine the tradeoffs made among spending options or, to a less controllable degree, revenue sources.

Spending and revenue patterns are crucial not just to the classification of institutions, but to the entire philosophy of higher education as an enterprise. Williams (1984) states that governments can influence the behavior of higher education systems by altering the terms on which financial resources are made available. He goes on to say that the selling of services (such as research or consultancy) is likely to affect the internal resource allocation procedures of institutions. Therefore, how resources are allocated is a major determinant of the character of higher education institutions and systems. Expenditure patterns are of interest to all institutions, but especially to large, research-oriented, universities where instructional spending may not account for the majority of total dollars spent. The shares of total educational and general expenditures and mandatory transfers spent on areas such as instruction, research, public service, and student services (among others) are referred to as allocation ratios (Minter, et al., 1982). The use of ratios such as these allows meaningful comparisons to be made among institutions of different sizes. Because allocation ratios indicate the structure of operating expenditures (Woelfel, 1987), they can offer great insight into the priorities, tradeoffs, and missions of institutions; in short, allocation ratios offer a meaningful way to classify institutions. Indeed, because they focus on structure rather than size, ratios may be better classifying criteria than many currently being used.

The purpose of this paper, then, is twofold: 1) to empirically determine spending patterns of institutions and the tradeoffs made among competing financial needs by certain types of institutions, and 2) to determine how well these expenditure patterns may validate the Carnegie classifications of the examined institutions. The latter purpose is emphasized more strongly than the former, particularly concerning how the institutions studied would be reclassified into other Carnegie groups based solely on their spending patterns (as reflected in their allocation ratios).

METHOD

Data were collected for 133 public, doctorate-granting institutions in the Research I, Research II, Doctorate-granting I, and Doctorate-granting II Carnegie classification groups. The following financial variables were included as part of the study: total fiscal year 1988 educational and general expenditures and mandatory transfers (E&G), and percent of E&G spent on each of instruction, research, public service, academic support, institutional support, student services, and operation and maintenance of plant. Also, each institution's Carnegie classification group was included as part of the study.

Table 1 shows the number and mean values of the institutions in each Carnegie group and for all groups combined.

Insert Table 1 About Here

For each of the allocation ratios and for total E&G, Pearson correlation coefficients were calculated to determine the interrelationships among the financial variables.

To achieve the second purpose, discriminant analysis was performed using the institution's Carnegie classification group as the identifier variable and the seven allocation ratios as the discriminator variables. Since the proportion of institutions in each Carnegie group is known, prior probabilities based on the size of each group were used to adjust the projected probabilities of group membership.

Predicted classifications for the entire group of institutions were obtained and compared to actual classifications for accuracy. Two different discriminant analyses were performed, one using a two-level identifier (Research and Doctorate-granting) and the other using a four-level identifier (Research I, Research II, Doctorate-granting I, and Doctorate-granting II). This was done in order to test the rigidity of the classification scheme used by Carnegie. It was hypothesized that more reclassification of institutions would take place within the Research and Doctorate-granting groups than would take place between the two groups because of the differing nature of the criteria necessary for inclusion in the groups (Doctorate-granting institutions must award a certain number and variety of doctoral degrees; Research institutions must award a certain number of doctoral degrees and receive a certain amount of federal support for research and development).

RESULTS AND DISCUSSION

Table 2 shows the matrix of Pearson correlation coefficients for the financial variables included in the study. Only research and public service are positively correlated with total E&G expenditures; all other allocation ratios show negative relationships with E&G. Also striking are the strong negative correlations that instruction shows with research and public service; the relationship between instruction and research shows the strongest correlation ($r = -0.811$) between any two variables in the study.

Insert Table 2 About Here

While percent spent on instruction is negatively correlated with E&G, research, and public service, it shows significant positive relationships with student services, institutional support, and plant operation. In fact, the "supportive" functions (as compared to the primary functions of instruction, research, and public service) generally show significant positive correlations with one another, but significant negative correlations with E&G, research, and public service.

Strong correlations among instruction, research, and public service may be expected because these expenditures are directly related to outputs of the institution. The support functions show negative correlations with E&G perhaps because certain economies of scale exist in those functions. Also, there are tradeoffs among all items on a proportional (ratio) and even on an absolute (dollar) basis. Therefore, in terms of tangible or intangible units, there may be substitutes (implying tradeoffs) or complements (e.g., student services and academic support may be complementary inputs with instructional inputs).

Generally, then, the greater the expenditures of an institution, the greater the percent spent on research and public service, and the smaller the share spent on instruction and the supportive functions. Of course, research and (to a lesser extent) public service tend to be funded by external sources and are therefore additive in nature to the expenditure base. The funds given to an institution for research are of course spent on research, which adds to the size of total E&G and decreases the percent (though <u>not</u> the absolute dollar amount) spent on instruction and support.

Correlations among these variables may also be examined for each Carnegie group separately. Pearson correlation coefficients are shown in Table 3 by Carnegie group for selected financial variables (percentages spent on academic support, student services, institutional support, and operation of plant have been combined into a variable called "support").

Insert Table 3 About Here

Interestingly, the strong relationships found between E&G expenditures and allocation ratios for all institutions are not present when examining each Carnegie group separately. For example, the correlation between E&G and research for all institutions is positive and significant ($r = 0.519$, $p = .0001$), but for Research I institutions the correlation is negligible ($r = 0.030$, $p = .8472$) and for Research II institutions is negative ($r = -0.291$, $p = .1495$). Clearly, the restriction of range for E&G has a significant effect on its relationship with the allocation ratios. Considering the allocation ratios among themselves, the relationships between research and instruction, research and support, instruction and public service, and public service and support generally remain strong and negative for each Carnegie group, as they are in the overall model. It can be said, then, that institutions in the same Carnegie groups have very similar spending patterns when institutional "size" (as reflected in total E&G expenditures) is disregarded.

Having described spending patterns and tradeoffs for the institutions in the study, those spending patterns (as reflected in allocation ratios) are used here to validate the Carnegie classifications of the institutions. In particular, what types of institutions would be reclassified (based solely on their allocation ratios) is examined here, as is the accuracy of the models in predicting actual Carnegie classification.

Tables 4 and 5 show the confusion matrices for the four- and two-level identifier models, respectively. The four-level model correctly classified Research I institutions 82.2% of the time versus only 15.4% accuracy for Research II institutions. Similarly, Doctorate-granting I schools were classified correctly 63.3% of the time versus 43.8% accuracy for Doctoral II schools. Overall, the four-level model was accurate in its classification in 55.6% of all cases.

Insert Table 4 About Here

Generally, institutions were most widely reclassified into the Research I and Doctoral I categories from the Research II and Doctoral II categories, respectively. For example, 12 of the 26 Research II institutions (46.2%) were reclassified into the Research I category. Conversely, only 17.8% of the Research I institutions were reclassified into other groups. The institutions that changed Carnegie groups in this analysis tended to be those with dissimilar research ratios relative to their fellow true group members. For example, the eight Research I institutions that were reclassified (Rutgers, North Carolina, Illinois-Chicago, SUNY-Stony Brook, Indiana, Connecticut, Colorado State, and New Mexico) spent a much smaller share of E&G expenditures on research than did the average Research I institution (14.6% versus 23.7%). The five Doctoral II institutions that were reclassified as Research I (Alabama-Birmingham, New Hampshire, Idaho, North Dakota State, and Missouri-Rolla) had a mean percentage spent on research of 21.6% versus the Doctoral II mean of 11.1%.

Earlier it was hypothesized that more reclassification would take place within the Research and Doctorate-granting groups than would take place between the two combined groups. This hypothesis was formed as a result of the differing nature of criteria necessary for inclusion into one group or the other.

The four-level identifier model was used to test this hypothesis. Of the 59 institutions that were reclassified in the four-level model shown in Table 4, 34 (57.6%) stayed within their Research or Doctoral combined group, while the other 25 (42.4%) went from a Research group to a Doctoral group or vice versa. Therefore, it can be said that there was more intragroup than intergroup reclassification, although not by the margin that may have been anticipated.

The confusion matrix in Table 5 has the Research I and II institutions combined into one group, and the Doctorate-granting I and II schools combined to form the other. This model correctly classified Research institutions 78.9% of the time, and was accurate in 79.0% of the cases for Doctorate-granting schools, for an overall accuracy rate of 78.9%.

Insert Table 5 About Here

Once again, the allocation for research intervenes to reclassify institutions. The 15 Research institutions reclassified as Doctorate-granting (Rutgers, Temple, SUNY-Stony Brook, Indiana, Arizona State, SUNY-Buffalo, California-Santa Barbara, Connecticut, South Carolina, Southern Illinois, Florida State, Delaware, West Virginia, SUNY-Albany, and Rhode Island) spent an average of 13.5% on research, versus 21.4% for all Research institutions. Conversely, the 13 Doctorate-granting institutions reclassified as Research (Alabama-Birmingham, Clemson, Alabama, Vermont, Arkansas, California-Riverside, New Hampshire, Idaho, Nevada-Reno, North Dakota State, Missouri-Rolla, Texas-Dallas, and Colorado School of Mines) spent an average of 22.5% on research, versus 9.6% for all Doctoral institutions.

Of course, those reclassified institutions with higher research allocations than their fellow true group members will also tend to spend a smaller share on instruction and on support than

their peers, because the correlations between research and both instruction and support are significant and negative within each Carnegie group and overall. Therefore, other variables can help explain the reclassifications, albeit in an indirect way, because the allocation for research drives the other ratios down by its additive nature.

Those institutions moving "up" from Doctoral to Research generally tend to be institutions with smaller enrollments and more emphasis on the sciences and engineering than their counterparts. Therefore, their total E&G expenditure bases tend to be smaller than the Research institutions', but their allocations for research are very close to those of Research institutions (22.5% versus 21.4% of E&G). The Research institutions reclassified as Doctoral generally tend (with a few notable exceptions) not to emphasize the sciences and engineering as much as their counterparts. So while they do spend millions of dollars on research, their research spending as a percent of E&G tends to be lower than other Research institutions'.

A practical limitation of this reclassification scheme is that many of the institutions in the study have medical schools (which are an obvious advantage in attracting research funds), some of which are included in the financial statements of the institutions, while others appear as separate financial operations (often in another city in the state). Thus some institutions, if their medical schools were included as part of their operations, would of course show different patterns of reclassification.

CONCLUSION

This study has examined the tradeoffs that public, doctorate-granting institutions make in the expenditure of their resources. Also, how these institutions' spending patterns may validate the Carnegie classification scheme, as well as what kinds of institutions would be reclassified based on their spending patterns, has been examined.

Since ratios negate size of institutions as a factor, perhaps ratios should be part of more classification schemes. Ratios can put all institutions on a "level playing field" so that structure rather than size can be examined as the key criterion. For example, Doctoral II institutions that have spending patterns similar to Research I institutions should be included among those larger institutions in certain analyses. Ratios can measure how any institution spends what it has, regardless of its current size or limitations.

The shares of its funds that an institution spends on instruction, research, public service, and support functions can tell a great deal about that institution's mission, priorities, and character. Therefore, it is suggested here that these ratios are an excellent way (although just one of many) of classifying peer institutions. Classification schemes such as those used by Carnegie might be well served in using certain ratios along with absolute measures of size and other criteria to classify institutions.

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TABLE 1: FREQUENCIES AND MEAN RATIOS FOR FY 1988 PUBLIC DOCTORAL INSTITUTIONS BY CARNEGIE CLASSIFICATION GROUP

	Research I	Research II	Doctorate-Granting I	Doctorate-Granting II	All Institutions
NUMBER IN SAMPLE	45	26	30	32	133
E&G EXPENDITURES (millions of dollars)	404.5	203.0	121.7	80.0	223.3
PERCENT SPENT ON:					
Instruction	35.1	37.7	44.1	42.8	39.5
Research	23.7	17.4	8.1	11.1	15.9
Public Service	7.7	7.4	4.3	4.2	6.0
Academic Support	9.2	9.2	10.5	9.5	9.6
Student Services	3.3	4.4	5.6	5.3	4.5
Institutional Support	6.8	8.1	10.1	9.0	8.3
O&M of Plant	7.5	8.7	9.1	9.8	8.6

TABLE 2: PEARSON CORRELATION COEFFICIENTS FOR FINANCIAL VARIABLES

	Instruction	Research	Public Service	Academic Support	Student Services	Instit. Support	O&M of Plant
E&G Expenditures	-0.383**	0.519**	0.194*	-0.005	-0.363**	-0.316**	-0.385**
Instruction	---	-0.811**	-0.506**	0.153	0.273**	0.243**	0.369**
Research		---	0.368**	-0.306**	-0.446**	-0.498**	-0.478**
Public Service			---	-0.404**	-0.379**	-0.389**	-0.411**
Academic Support				---	0.238**	0.174*	-0.064
Student Services					---	0.188*	0.098
Institutional Support						---	0.434**
O&M of Plant							---

* $p < .05$
** $p < .01$

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TABLE 3: PEARSON CORRELATION COEFFICIENTS FOR SELECTED FINANCIAL VARIABLES BY CARNEGIE CLASSIFICATION

	CARNEGIE CLASSIFICATION					
SELECTED FINANCIAL VARIABLES	Research I	Research II	Doctorate-Granting I	Doctorate-Granting II	All Research	All Doctorate-Granting
E&G Expenditures & Research	0.030	-0.291	0.361*	0.383*	0.217	0.247
E&G Expenditures & Instruction	0.157	0.059	-0.427*	-0.442*	-0.028	-0.356**
E&G Expenditures & Public Service	-0.209	-0.233	0.566*	0.467**	-0.148	0.478**
E&G Expenditures & Support	-0.029	0.363	-0.203	-0.253	-0.138	-0.136
Research & Instruction	-0.774**	-0.816**	-0.661**	-0.794**	-0.781**	-0.725**
Research & Public Service	-0.102	0.682**	0.409*	0.355*	0.133	0.365**
Research & Support	-0.466**	-0.620**	-0.474**	-0.629**	-0.562**	-0.563**
Instruction & Public Service	-0.206	-0.673**	-0.448*	-0.548**	-0.383**	-0.491**
Instruction & Support	0.285	0.284	-0.055	0.316	0.328**	0.128
Public Service & Support	-0.567**	-0.750**	-0.594**	-0.471**	-0.614**	-0.529**

* $p < .05$
** $p < .01$

TABLE 4: CONFUSION MATRIX FOR FOUR-LEVEL IDENTIFIER MODEL

NUMBER OF OBSERVATIONS AND PERCENTS CLASSIFIED INTO CARNEGIE CLASSIFICATIONS:

TRUE CARNEGIE CLASSIFICATION:	Research I	Research II	Doctoral I	Doctoral II	TOTAL
Research I	37	4	1	3	45
Percent	82.2%	8.9%	2.2%	6.7%	100.0%
Research II	12	4	3	7	26
Percent	46.2%	15.4%	11.5%	26.9%	100.0%
Doctoral I	4	0	19	7	30
Percent	13.3%	0.0%	63.3%	23.3%	100.0%
Doctoral II	5	2	11	14	32
Percent	15.6%	6.3%	34.4%	43.8%	100.0%
TOTAL	58	10	34	31	133
Percent	43.6%	7.5%	25.6%	23.3%	100.0%
PRIOR PROBABILITIES	33.8%	19.6%	22.6%	24.1%	

TABLE 5: CONFUSION MATRIX FOR TWO-LEVEL IDENTIFIER MODEL

NUMBER OF OBSERVATIONS AND PERCENTS CLASSIFIED INTO CARNEGIE CLASSIFICATIONS:

TRUE CARNEGIE CLASSIFICATION:	Research I & II	Doctoral I & II	TOTAL
Research I & II	56	15	71
Percent	78.9%	21.1%	100.0%
Doctoral I & II	13	49	62
Percent	21.0%	79.0%	100.0%
TOTAL	69	64	133
Percent	51.9%	48.1%	100.0%
PRIOR PROBABILITIES	53.4%	46.6%	